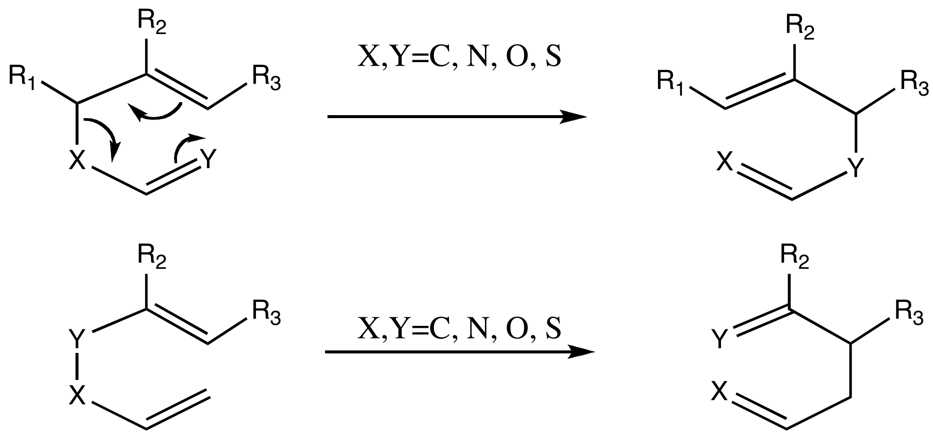
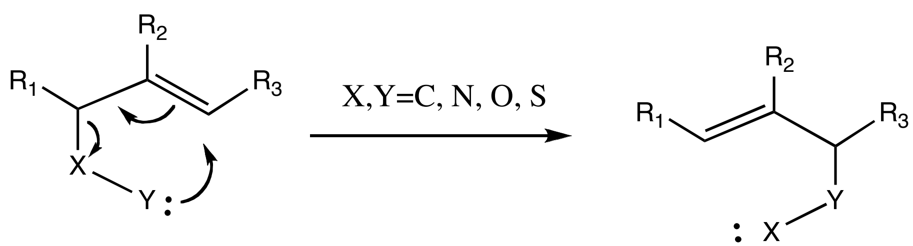
Generalized Sigmatropic Processes

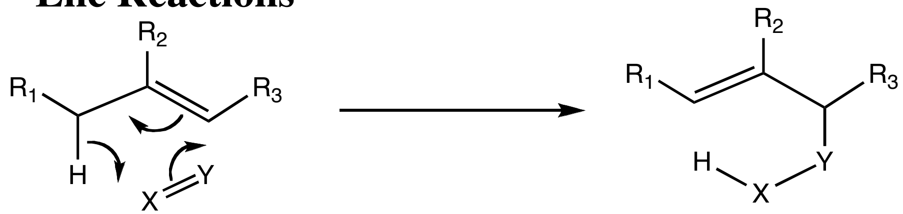
[3,3]-sigmatropic Processes



[2,3]-sigmatropic Processes

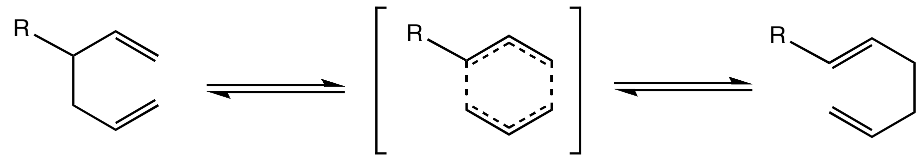


Ene Reactions

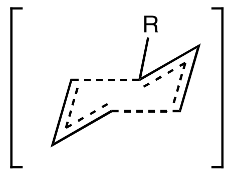


[3,3]- Sigmatropic Rearrangements

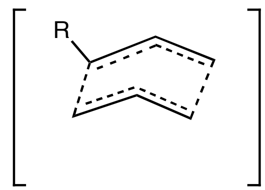
Cope Rearrangement



Transition states:



chair

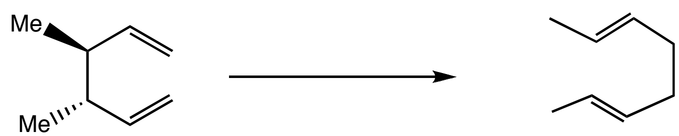


boat

(+5.3 kcal/mol)

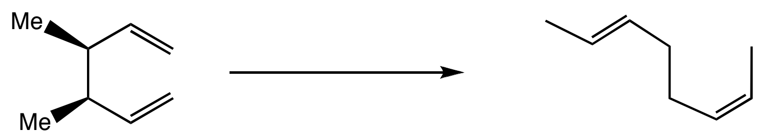
disfavored

Rationalize:



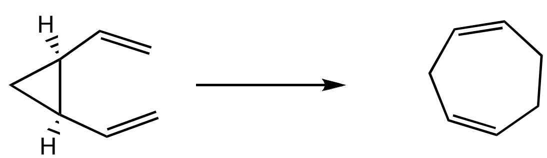
trans-trans 90%

Tetrahedron, **1962**, 67

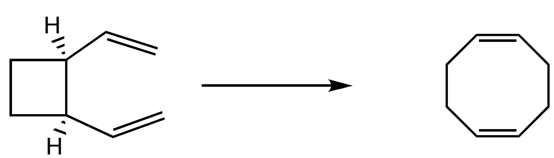


trans-cis 97%

Ring Strain can be employed to drive the Cope process:

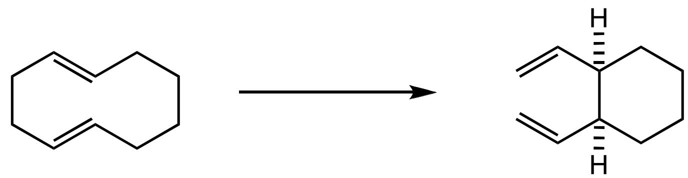


Chem. Commun, **1973**, 319



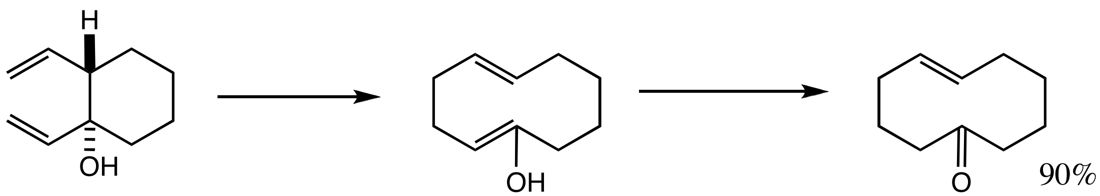
Annalen, **1958**, 1.

Position of Equilibrium dictated by ring strain issues:



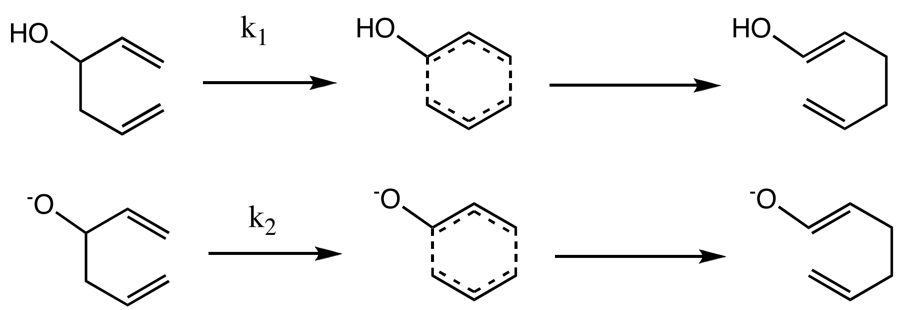
JOC, **1973**, 4117.

However, Tautomerism can shift the equilibrium:

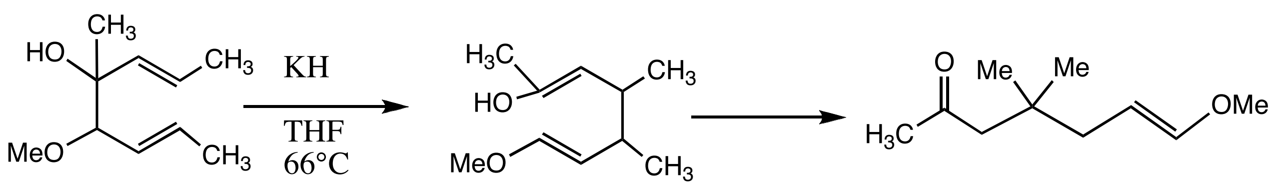


Tet. *Let*. **1970**, 509

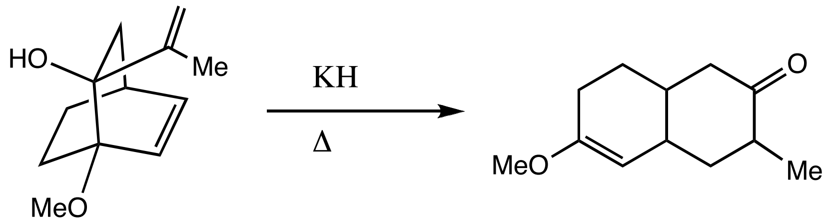
Anion-Accelerated Cope Rearraangements:



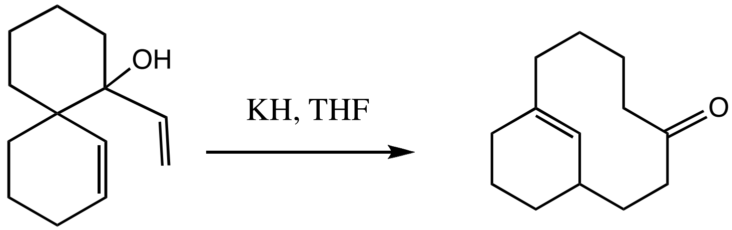
$k_2/k_1 = 10^{10} - 10^{17}$



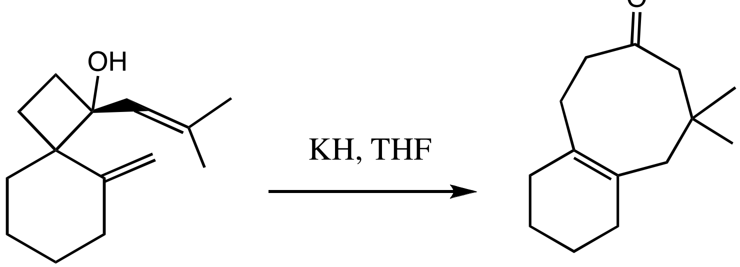
Examples:



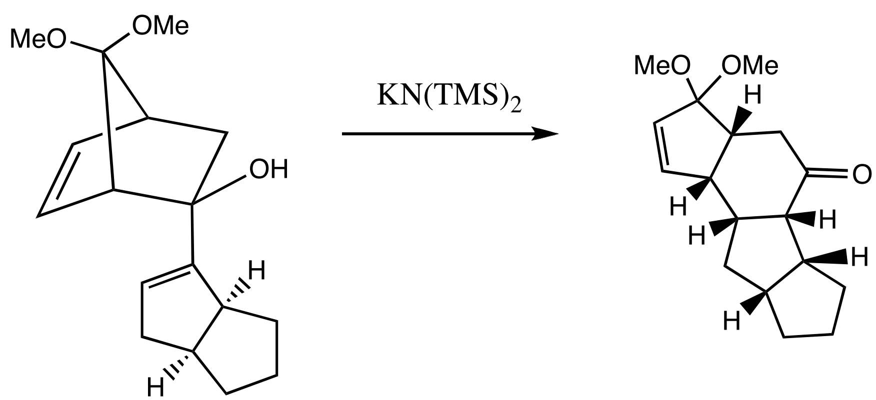
JACS, **1972**, 4779



JOC, **1981**, 2199.

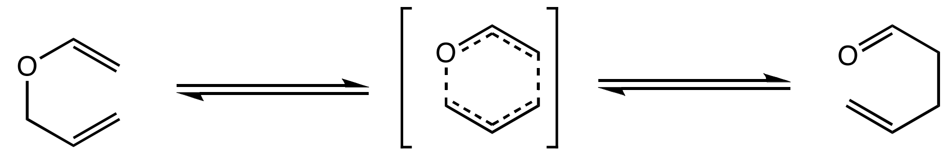


JOC **1982**, 2268

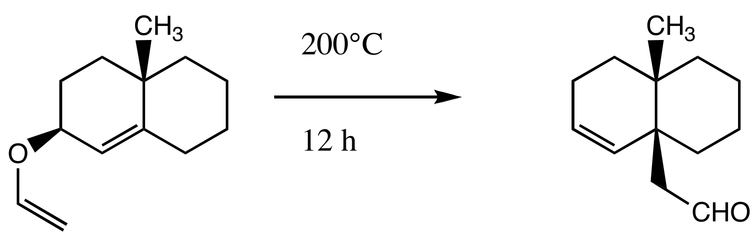


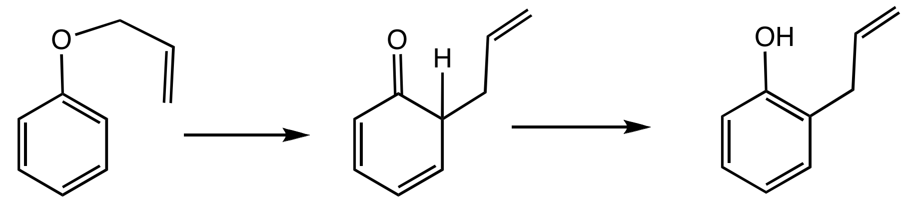
JACS, **1988**, 879.

The Claisen Rearrangement

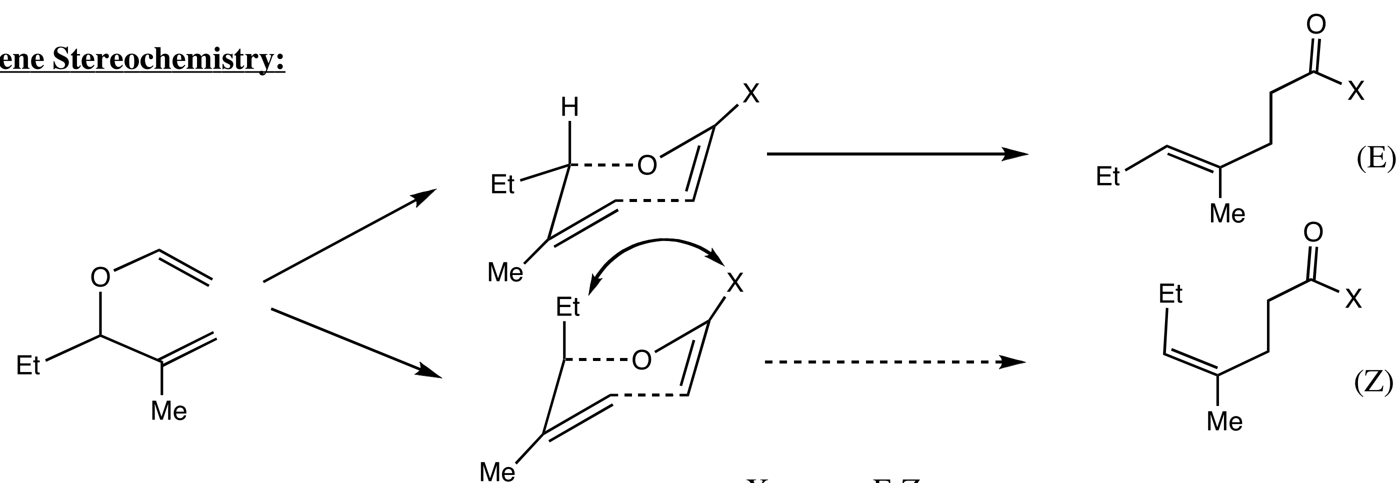


unsaturated carbonyl is thermodynamically favored:
process driven by the formation of the more stable C=O





Alkene Stereochemistry:

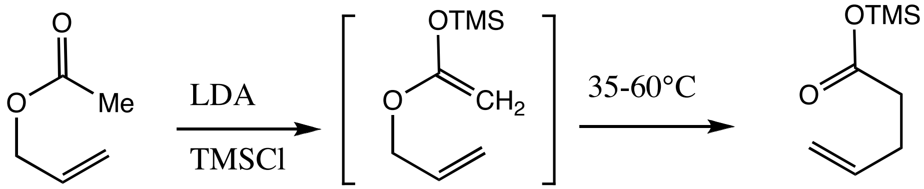


X	E:Z
H	90:10
Me	>99:1
OMe	>99:1
Me_2N	>98:2

Tet, Let. **1969**, 3243
JACS, **1973**, 553
JACS, **1970**, 741

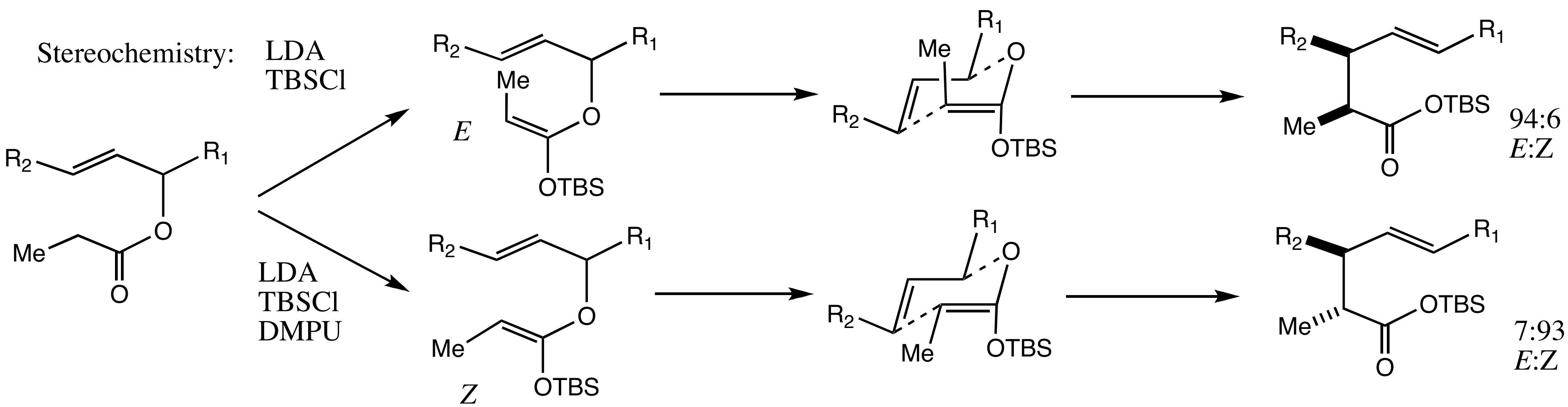
Ireland Enolate Claisen

A low temperature, mild variant of the Claisen process:



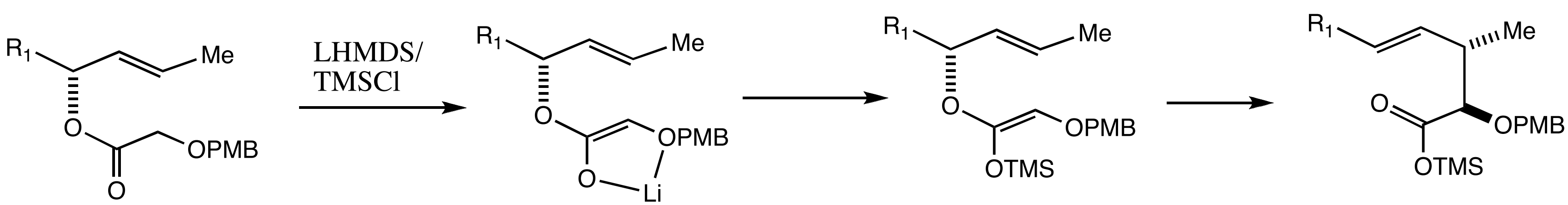
Enolates that do not fragment may be used without silyl trapping to afford the carboxylic acid products. Enolate rearrangements occur at 25°C.

Stereochemistry:



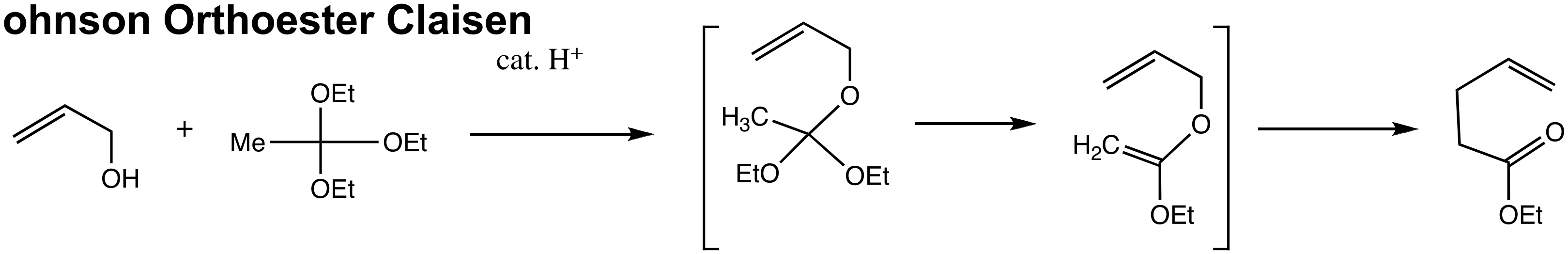
JOC, **1991**, 650.

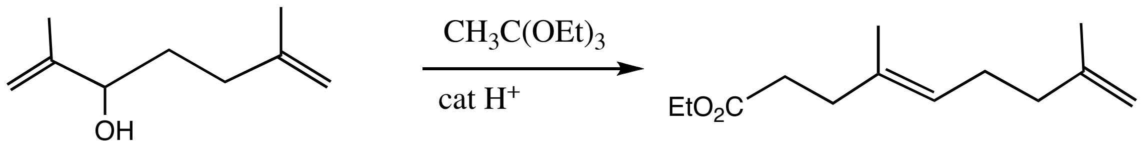
Chelating Substituents favor Z-Enolates:



TL **1993**, 1103.

Johnson Orthoester Claisen

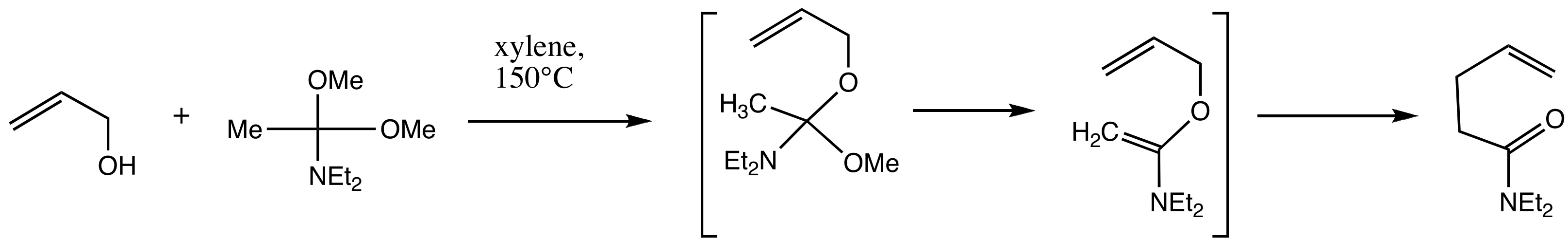


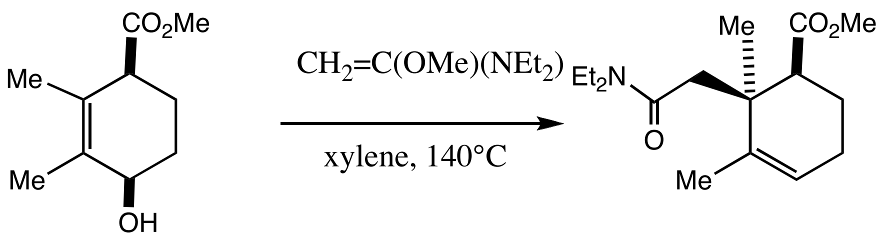


92% (E:Z = 98:2)

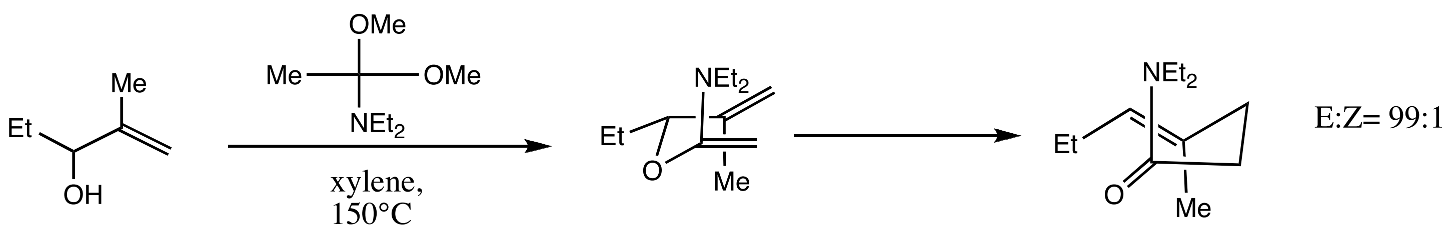
JACS, **1970**, 741

Eschenmoser Claisen



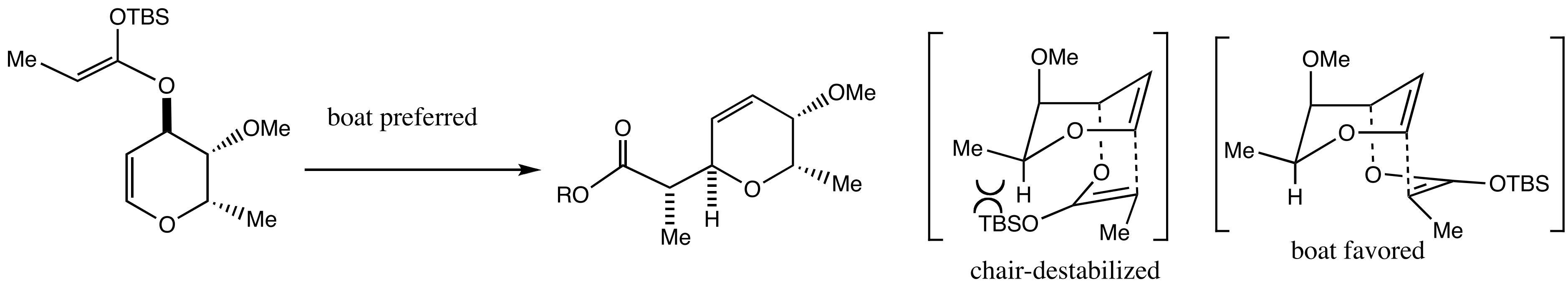


Helv. *Chim Acta*, **1964**, 2425.

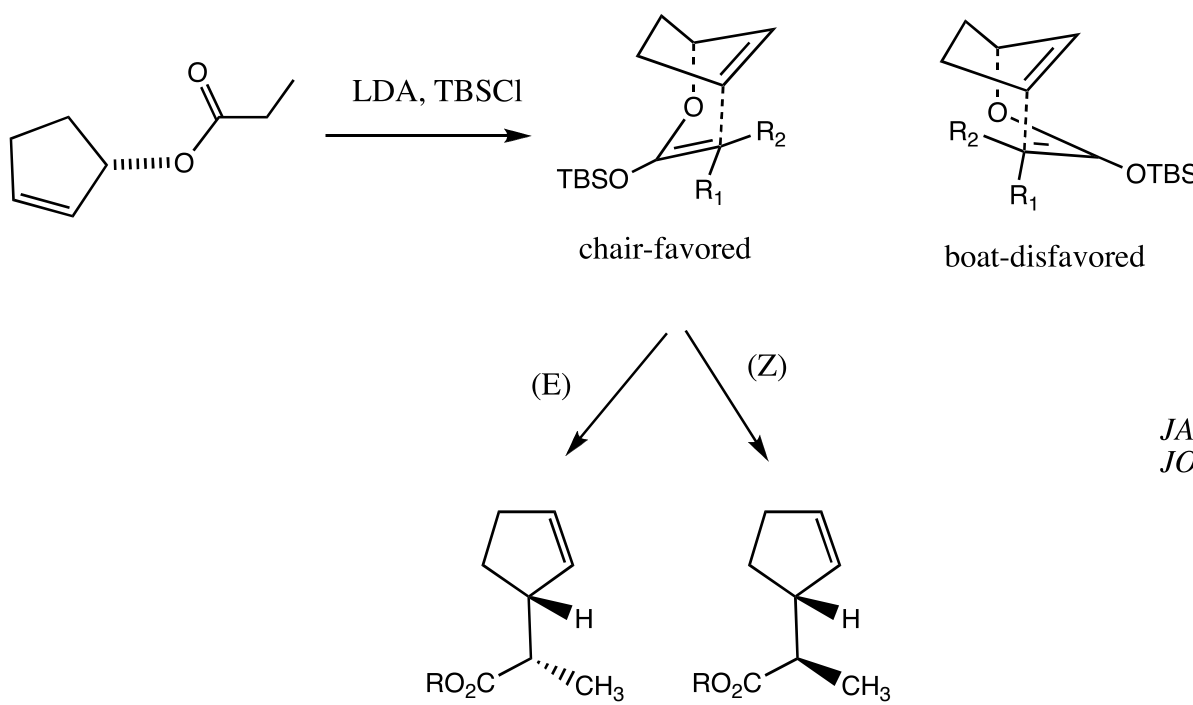


E:Z= 99:1

Boat Transition States are more accessible in Claisen than in Cope Rearrangements

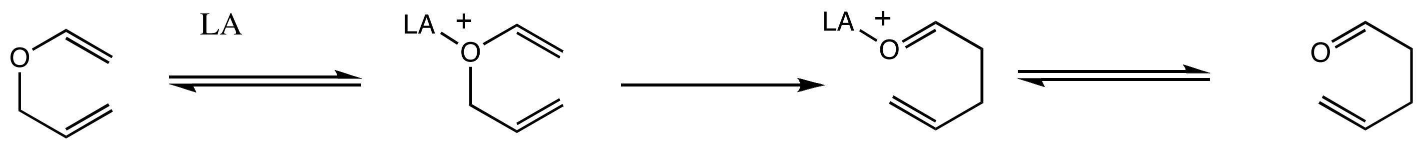


However,

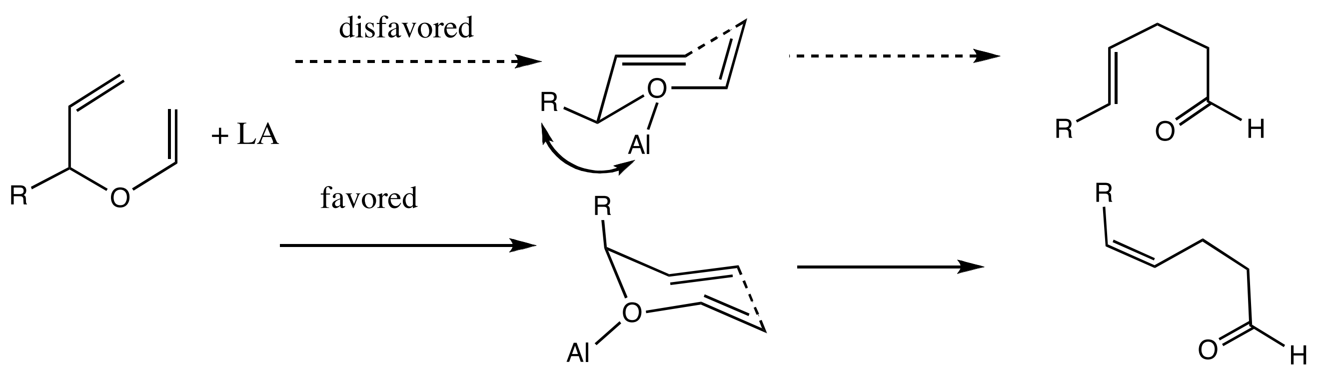


JACS, **1991**, 3572
JOC, **1981**, 3896

Lewis Acid Catalysis of the Claisen Rearrangement



Lewis Acids: Et_2AlCl *JOC*, **1970**, 3166
$TiCl_4$: *Chem Lett*. **1975**, 1041
$(RO)_2$ AlMe *JACS*, **1988**, 7922; *TL*, **1989**, 1265; *JACS*, **1990**, 316
$LiClO_4$, *Tet*, **1993**, 6025

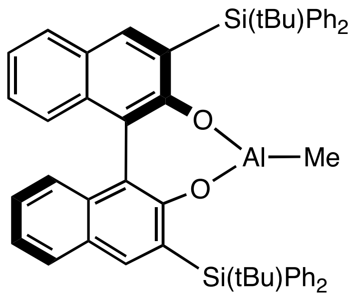


R=*iBu*	allyl
19	7
81	93

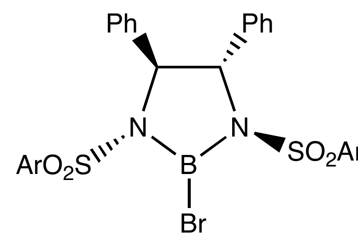
JACS, **1990**, 316

Enantioselective Claisen Rearrangements

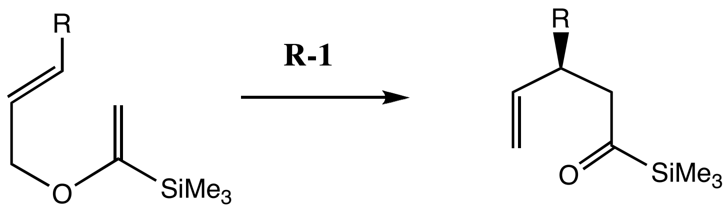
R-1



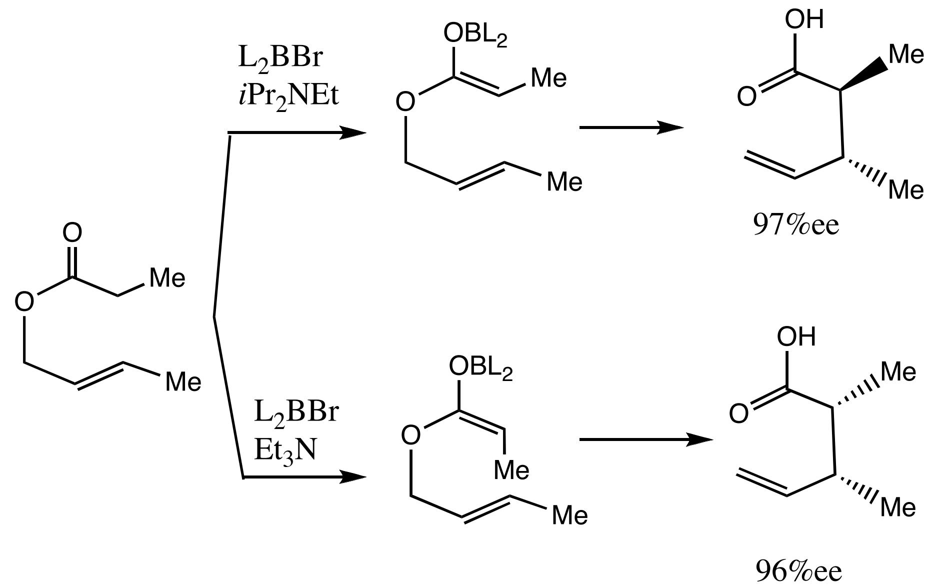
Yamamoto, *JACS*, **1990**, 7791



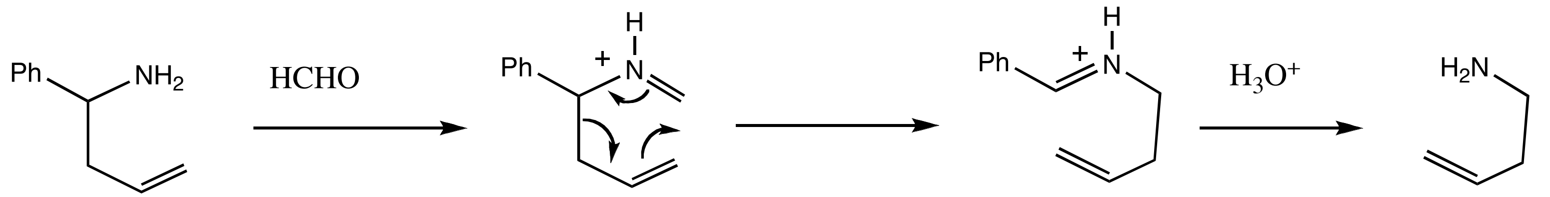
Corey, *JACS*, **1991**, 4026



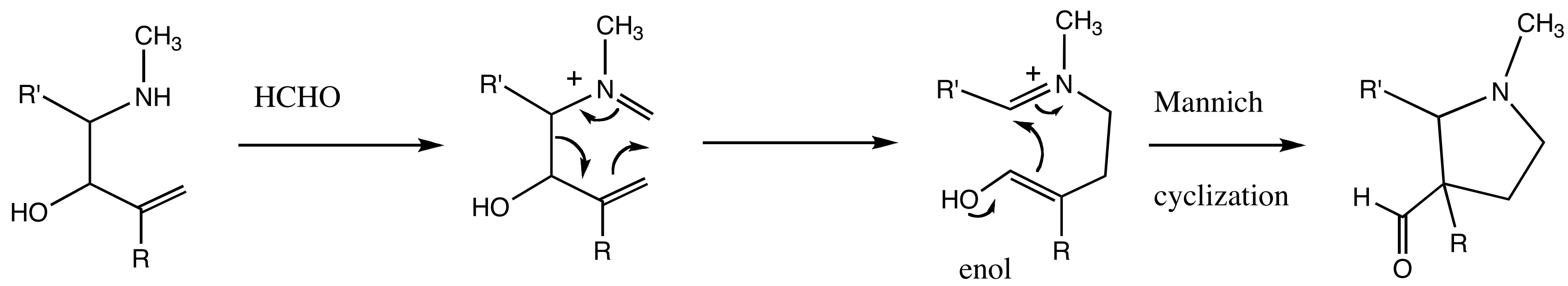
R=Ph, 88%ee
R=C_6H_{11} 71%ee



The Aza-Cope Rearrangement

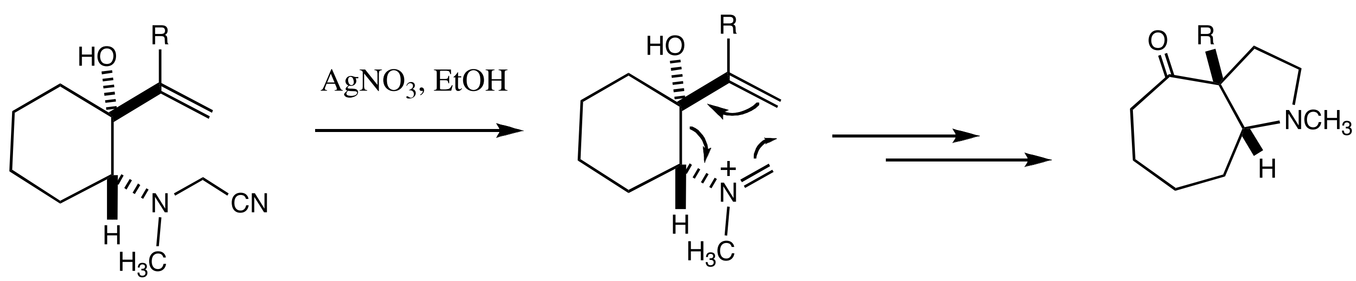


Aza-Cope Mannich Process



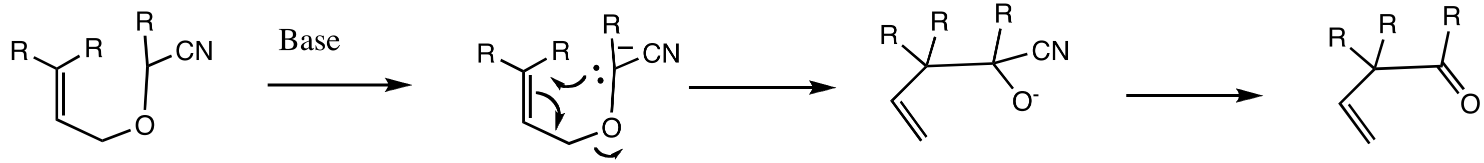
JACS, **1988**, 4329

JACS, **1988**, 685

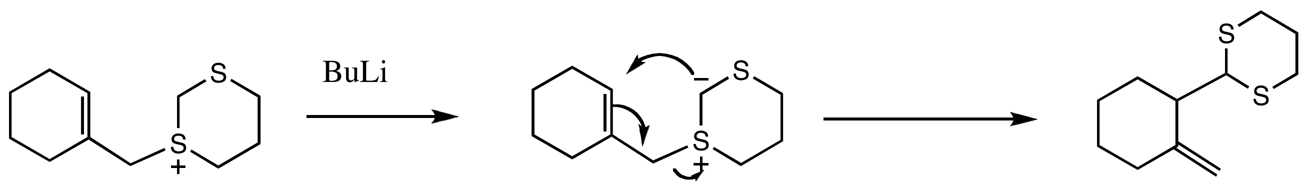


R	yield
Me	78%
H	64%
SPh	76%
OEt	37%

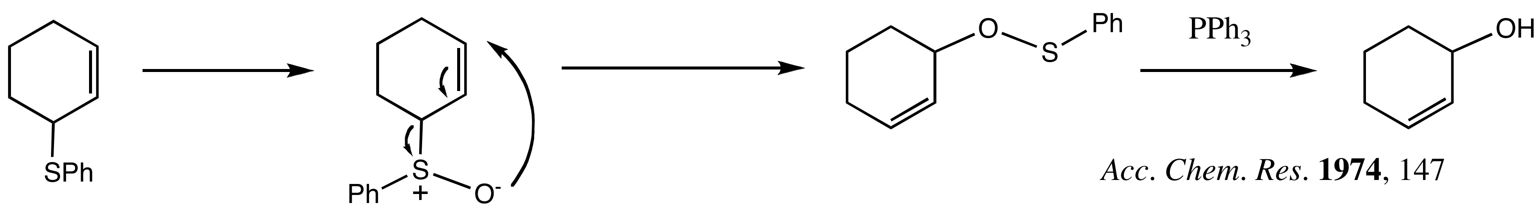
[2,3]-Wittig Reaction



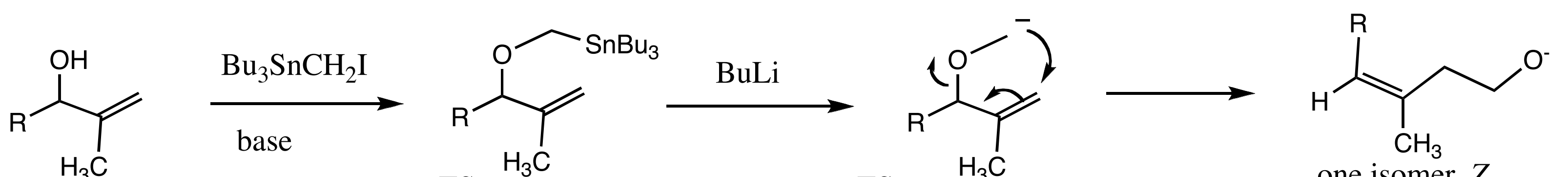
TL, **1974**, 2077

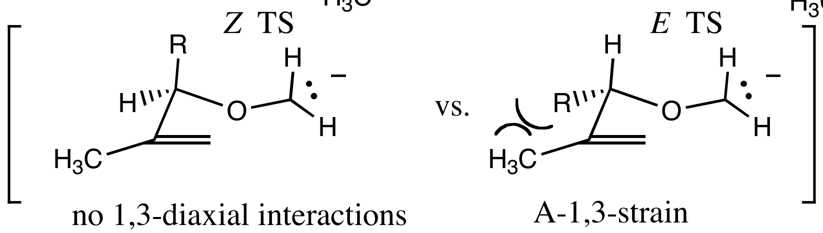


Chem. Commun, **1972**, 757



Acc. Chem. Res. **1974**, 147

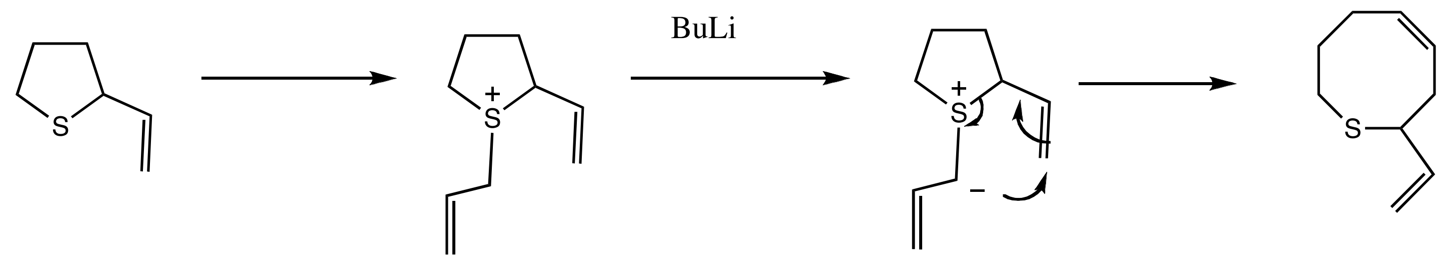




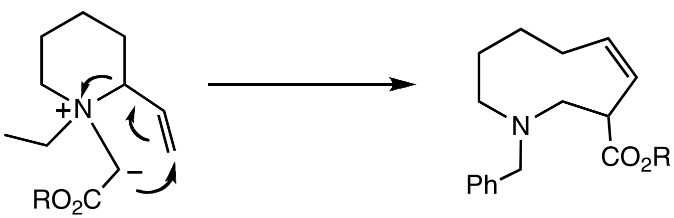
JACS, **1978**, 1927

when A-1,3 strain is removed, E/Z selectivity is reduced.

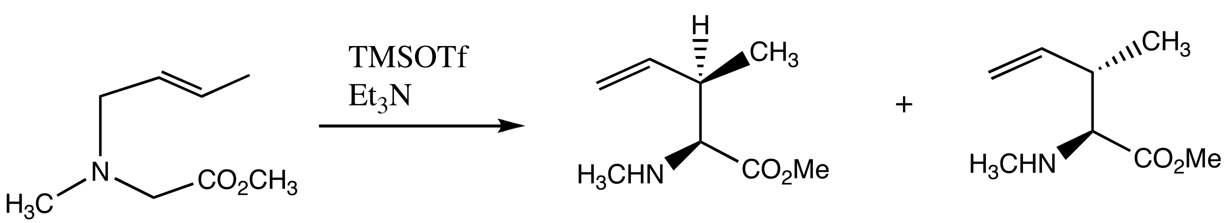
Applications of the 2,3-Wittig in Synthesis



JACS, **1975**, 6878
JOC, **1978**, 1185
TL, **1978**, 519



JOC, **1962**, 3572



81 : 19

Chem Lett. **1990**, 2069.